Inverting COSMIC-2 Phase Data to Bending Angle and Refractivity Profiles using Full Spectrum Inversion Method
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Introduction: We present an initial quality assessment (SNR characteristics) of the CDAAC COSMIC-2 Level L1b data and present an inversion algorithm (STAR processing) to retrieve bending angle and refractivity from phase data using the Full Spectrum Inversion (FSI) method.

Data: UCAR Processed Level L1b (conPhs) data for October 2019 was used for inversion, and UCAR Level 2 (atmPrf) and collocated ERA-5 data were used for validation.

NOAA STAR Inversion System:

- **Input phase and amplitude**
- **Coordinate Transform** (ECI to ECEF)
- **Estimation of Occultation Point**
- **Signal Truncation**
- **Excess Phase Reconstruction/L2 Phase Correction**
- **Computation of L1 & L2 Bending Angles**
- **Ionospheric Correction/Optimization**
- **Quality Control**
- **Initialization and Abel Inversion**
- **Output Bending Angle/Refractivity**

![Fig 1. Count of COSMIC-2 observations (a) daily from June 17 – October 31, 2019, (b) at 5x5° longitude and latitude bins, and (c) at local solar times for October 2019.](image)

![Fig 2. (a) Distribution of SNR at L1 and L2 frequencies for October 2019, and (b) daily averaged SNR of all the RO measurements for that day.](image)

![Fig 3. Flowchart of the different steps used in the STAR processing.](image)

![Fig 4. Fractional difference between STAR (a) bending angle, (b) refractivity, and UCAR Level 2 (c) bending angle, (d) refractivity with collocated ERA-5 data.](image)

COSMIC-2 SNR Characteristics: The SNR for each profile is calculated as the average SNR in the 60 – 80 km impact height. The bimodal SNR at L2 frequency is due to different SNR characteristics of GPS and GLONASS.

Validation: The mean bias (standard deviation) of bending angle and refractivity relative to ERA-5 are 0.2 (4.6) and 0.03 (1.4) %, respectively. For comparison, the bias and standard deviation of atmPrf (UCAR Level 2) bending angles and refractivity are 0.1 (3.8) and 0.02 (1.09) %, respectively.

Summary and Conclusion: The L1 frequency SNR in COSMIC-2 data has a mean of 1500 v/v. The STAR processed bending angle and refractivity have comparable mean bias and standard deviation compared to UCAR processed Level 2 data and provides independent set of RO Level 2 data.

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